

PATENT ABSTRACTS OF JAPAN

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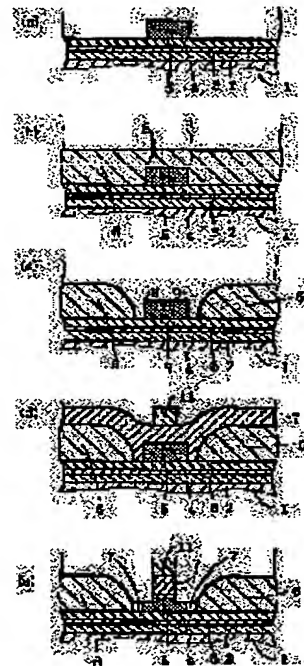
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(54) MAGNETIC DISK DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To realize high density, small size and fast access time by forming such a region in a joined part that the outer edge of a first joining face and the outer edge of a second joining face are directly joined without an insulating material interposed.

SOLUTION: The outer edges 8, 9, 10 of the joining face of a first conductive layer 5 are exposed. Then a second conductive layer 7 such as copper having thin adhesive layers such as chromium on both surfaces is formed and etched through a mask 11 to obtain a direct joined structure between the whole joining face of the first conductive layer 5 and the whole joining face of the second conductive layer 7. By this method, a joined structure having no insulating material around the joined part of the first conductive layer 5 and the second conductive layer 7 can be obt'd. and this joined part hardly causes peeling during heat treatment.



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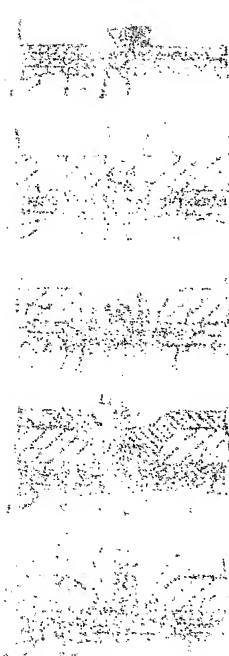
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CLAIMS

[Claim(s)]

[Claim 1] In the magnetic disk drive equipped with the magnetic head which records said data on the magnetic disk for recording data, and this magnetic disk, and they are made to reproduce The first conductor layer by which said magnetic head is the laminated structure to which the laminating of a conductor layer and the insulator layer was carried out, and the laminating was carried out to the field which counters the substrate of said insulating layer among said conductor layers, It is mutually joined electrically in the joint which joined the first plane of composition where the second conductor layer by which the laminating was carried out to the field of another side of said insulating layer was formed in said first conductor layer, and the second plane of composition formed at said second conductor layer. The magnetic disk drive characterized by having the field joined directly, without the rim section of said first plane of composition and the rim section of said second plane of composition sandwiching an insulator in said joint.

[Claim 2] In the magnetic disk drive equipped with the magnetic head which records said data on the magnetic disk for recording data, and this magnetic disk, and they are made to reproduce The first conductor layer by which said magnetic head is the laminated structure to which the laminating of a conductor layer and the insulator layer was carried out, and the laminating was carried out to the field which counters the substrate of said insulating layer among said conductor layers, It is mutually joined electrically in the joint which joined the first plane of composition where the second conductor layer by which the laminating was carried out to the field of another side of said insulating layer was formed in said first conductor layer, and the second plane of composition formed at said second conductor layer. The magnetic disk drive characterized by having the field which thickness is thinning down in the first conductor layer near [said] the first plane of composition.

[Claim 3] In the magnetic disk drive equipped with the magnetic head which records said data on the magnetic disk for recording data, and this magnetic disk, and they are made to reproduce The first conductor layer by which said magnetic head is the laminated structure to which the laminating of a conductor layer and the insulator layer was carried out, and the laminating was carried out to the field which counters the substrate of said insulating layer among said conductor layers, It is mutually joined electrically in the joint which joined the first plane of composition where the second conductor layer by which the laminating was carried out to the field of another side of said insulating layer was formed in said first conductor layer, and the second plane of composition formed at said second conductor layer. Furthermore, the magnetic disk drive characterized by having the field joined in respect of said first conductor layer and said second conductor layer differing from said first plane of composition and said second plane of composition in said joint.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]

[0001]

[Field of the Invention] This invention relates to the magnetic disk drive equipped with the thin film magnetic head which starts a magnetic disk drive, especially has a thin film laminated structure.

[0002]

[Description of the Prior Art] In recent years, the magnetic disk drive equipped with the thin film magnetic head which has the structure which rolled many conductors about in the limited field as a means to attain densification of a magnetic disk drive and rapid access-ization is considered. For example, the magnetic disk drive equipped with the thin film magnetic head which carried out the laminating of the insulator layer indicated by JP,62-173607,A (henceforth a well-known technique) and the conductor layer can be considered.

[0003]

[Problem(s) to be Solved by the Invention] Since the thin film magnetic head of the well-known technique with which the magnetic disk drive is equipped can make width of face of a conductor coil small, without enlarging resistance of a conductor so that the thickness of a conductor layer is thick, the densification of the magnetic head and a miniaturization are enabled, and the densification of a magnetic disk drive and rapid access-ization are attained. However, the thin film magnetic head of a well-known technique has the problem that exfoliation and an open circuit take place in the joint of conductor layers in the case of heat treatments, such as heat curing of the photoresist in a production process, and annealing in a magnetic field, so that the thickness of a conductor layer is thick, cannot thicken the film of a conductor layer but has become the trouble of the densification of a magnetic disk drive, and rapid access-izing.

[0004] The technical problem of this invention is enabling the densification of the magnetic head, and a miniaturization and attaining densification of a magnetic disk drive, and rapid access-ization.

[0005]

[Means for Solving the Problem] When the thin film magnetic head of the well-known technique with which the magnetic disk drive is equipped studied exfoliation and the cause to disconnect wholeheartedly in the joint of conductor layers on the occasion of heat treatments, such as heat curing of the photoresist in the production process, and annealing in a magnetic field, it found out that the insulator by which it is placed between the rim sections of the plane of composition of conductor layers was the key factor of exfoliation or an open circuit. That is, since the coefficient of thermal expansion of the insulator which constitutes an insulator layer differed from the coefficient of thermal expansion of the conductor which constitutes a conductor layer, it checked that that the insulator by which it is placed between the rim sections of the plane of composition of conductor layers according to the difference of the amount of expansion of the insulator and conductor in heat treatment exfoliates, and disconnects a joint and its phenomenon were so remarkable that the thickness of a conductor layer is thick by analysis, experiment, etc.

[0006] The insulator by which it is placed between the plane-of-composition rim sections leading to exfoliation of this joint and an open circuit is required in order to prevent an open circuit of the conductor layer in a junction process.

[0007] The joint of the conductor layers of the conventional technique is formed of the following process:

[0008] An insulator layer is made to form on a process 1. conductor layer (henceforth the first conductor layer).

[0009] The center section of the plane of composition of the first conductor layer is exposed by removing a part of process 2. insulator layer. (An insulator layer is made to remain in the rim section of the plane of composition of the first conductor layer). The laminating of the conductor layer (henceforth the second conductor layer) joined to the process 3. first conductor layer is carried out on an insulator layer.

[0010] Process 4. etching removes the unnecessary section of the second conductor layer, and the plane of composition of the first conductor layer and the plane of composition of the almost same configuration are formed in the second conductor layer.

[0011] And the open circuit by the over etching to the first conductor layer in a process 4 is prevented by making an insulator layer remain in the rim section of the plane of composition of the first conductor layer at the above-mentioned process 2.

[0012] According to this approach, although thickness of a conductor layer cannot be thickened, since it is effective to prevention of an open circuit of the first conductor layer, it considers as the optimal approach.

[0013] However, since it became clear that the insulator by which it is placed between the plane-of-composition rim sections caused plane-of-composition exfoliation and an open circuit, and it was the cause which cannot thicken thickness of a conductor layer as mentioned above, if the insulator by which it is placed between these plane-of-composition rim sections is removed, exfoliation of a plane of composition and an open circuit can be prevented, and thickness of a conductor layer will be made further thickly.

[0014] The technical problem of this invention is solvable by constituting as follows in the magnetic disk drive equipped with the magnetic head which records said data on the magnetic disk for recording data, and this magnetic disk, and they are made to reproduce.

(1) The first conductor layer by which said magnetic head is the laminated structure to which the laminating of a conductor layer and the insulator layer was carried out, and the laminating was carried out to the field which counters the substrate of said insulating layer among said conductor layers. It is mutually joined electrically in the joint which joined the first plane of composition where the second conductor layer by which the laminating was carried out to the field of another side of said insulating layer was formed in said first conductor layer, and the second plane of composition formed at said second conductor

layer. It has the field joined directly, without the rim section of said first plane of composition and the rim section of said second plane of composition sandwiching an insulator in said joint.

[0015] (2) The first conductor layer by which said magnetic head is the laminated structure to which the laminating of a conductor layer and the insulator layer was carried out, and the laminating was carried out to the field which counters the substrate of said insulating layer among said conductor layers. It is mutually joined electrically in the joint which joined the first plane of composition where the second conductor layer by which the laminating was carried out to the field of another side of said insulating layer was formed in said first conductor layer, and the second plane of composition formed at said second conductor layer. It has the field which thickness is thinning down in the first conductor layer near [said] the first plane of composition.

[0016] (3) The first conductor layer by which said magnetic head is the laminated structure to which the laminating of a conductor layer and the insulator layer was carried out, and the laminating was carried out to the field which counters the substrate of said insulating layer among said conductor layers. It is mutually joined electrically in the joint which joined the first plane of composition where the second conductor layer by which the laminating was carried out to the field of another side of said insulating layer was formed in said first conductor layer, and the second plane of composition formed at said second conductor layer. Furthermore, it has the field joined in respect of said first conductor layer and said second conductor layer differing from said first plane of composition and said second plane of composition in said joint.

[0017]

[Embodiment of the Invention] First, the mechanism of the exfoliation and the open circuit in the junction structure of the conductor layers of the conventional thin film magnetic head used for a magnetic disk drive is explained using drawing 19. In this drawing, it has structure which carried out the laminating of the substrate film 2, the gap material 3, the first insulator layer 4, the first conductor layer 5, the second insulator layer 6, and the second conductor layer 7 on the substrate 1, and as shown in drawing 19 (a), it is placed between the plane-of-composition rim sections of the first conductor layer 5 and the second conductor layer 7 by the insulator 34. In the case of the thin film magnetic head, the photoresist is used as copper and an insulator as a conductor, and since the difference of these coefficients of thermal expansion is large, if it heat-treats, an insulator tends to expand more greatly than a conductor. If stress which pushes a joint open occurs, exfoliation arises into 35 of drawing 19 (b), and the part of 36 and this progresses by this so that it may be expressed with the arrow head in drawing 19 (b), as shown in drawing 19 (c), it will result in an open circuit. If not placed between the perimeters of a joint by the insulator, since stress which is expressed with the arrow head of drawing 19 (b) is not generated, exfoliation and an open circuit stop being able to happen easily.

[0018] Since it has the field which the rim sections of the plane of composition of the first conductor layer and the second conductor layer join directly in the thin film laminated structure formed of the laminating of a conductor layer and an insulator layer according to this invention, by the thermal expansion of an insulator, the stress by which induction is carried out is reduced and can prevent exfoliation and an open circuit of a joint. In addition, the film piece of the first conductor layer by the over etching in a production process can be prevented by adjusting the thickness of the first conductor layer.

[0019] Hereafter, the example of this invention is explained using a drawing.

[0020] First, the junction structure of the thin film magnetic head for magnetic disk drives which is the 1st example of this invention is explained using drawing 5 from drawing 1: Drawing 1 is thin film junction structural drawing of the conductor layers of the thin film magnetic head used for a magnetic disk drive, and the whole plane-of-composition surface of a conductor layer is joined directly. Drawing 2 and drawing 3 are the process sectional views for explaining the process and junction structure of manufacturing this. Drawing 2 is the sectional view in drawing 1 cut Field ABC, and drawing 3 is the sectional view in drawing 1 cut Field DEF. This structure is the structure which carried out the laminating of the substrate film 2, the gap material 3, the first insulator layer 4, the first conductor layer 5, the second insulator layer 6, and the second conductor layer 7 to the substrate 1, as shown in drawing 2 and drawing 3, but in order to clarify joint structure, only the first conductor layer 5 and the second conductor layer 7 are shown in drawing 1.

[0021] This first example is explained in accordance with a manufacture process. First, after forming the substrate film 2 and the gap material 3 by the sputter on a substrate 1 and applying insulators, such as a photoresist, on it, it is made to harden by heat treatment and the first insulator layer 4 with a flat front face is formed. If it besides etches by forming the first conductor layers 5, such as copper which has thin glue lines, such as chromium, on the inferior surface of tongue, it will be in the condition which shows in drawing 2 (a) and drawing 3 (a). Next, if the second insulator layer 6 which consists of a photoresist etc. is applied, it will be in the condition which shows in drawing 2 (b) and drawing 3 (b). Then, after exposing and developing the second insulator layer 6, if it heat-hardens, the condition which shows in drawing 2 (c) and drawing 3 (c) will be acquired. In this case, since it was conventionally made not exposed [the plane-of-composition rim sections 8, 9, and 10 of the first conductor layer 5], when insulators, such as a photoresist, were left behind to the top face of the plane-of-composition rim sections 8, 9, and 10 and the second conductor layer 7 was formed, it became the structure where it was placed between the plane-of-composition rim sections by the insulator. In the **** 1 example, as shown in drawing 2 (c) and drawing 3 (c), the plane-of-composition rim sections 8, 9, and 10 of the first conductor layer 5 are exposed. Then, the second conductor layers 7, such as copper which has thin glue lines, such as chromium, on a top face and the inferior surface of tongue, for example, are formed, and if it etches by attaching a mask 11, the structure which the whole plane-of-composition surface of the first conductor layer 5 and the whole plane-of-composition surface of the second conductor layer 7 join directly will be acquired. This process is shown in drawing 2 (d), drawing 2 (e), drawing 3 (d), and drawing 3 (e). If it does in this way, the junction structure where it is not placed between the perimeters of a joint of the first conductor layer 5 and the second conductor layer 7 by the insulator is acquired, and in case it is heat treatment, the structure which cannot produce exfoliation easily in this joint will be acquired. In this case, although over etching of the first conductor layer 5 is carried out and it becomes thin as shown in the part 12 of drawing 1, a film piece can be prevented by adjusting the thickness of the first conductor layer 5.

[0022] It is thin film junction structural drawing of the conductor layers of the thin film magnetic head where drawing 4 is also used for a magnetic disk drive, and the whole plane-of-composition surface of a conductor layer is joined directly. Although drawing 1 was the pictorial drawing into which it looked from the direction of the top face of the second conductor layer 7, drawing 4 is the pictorial drawing into which it looked from the direction of the inferior surface of tongue of the first conductor layer 5. Drawing 5 is the sectional view cut in respect of [GHI] drawing 4. This enlarges width of face of a mask 11 in the thin film junction structure of drawing 1 - drawing 3, and is obtained by transposing the process of etching shown in drawing 2 (d) and drawing 2 (e) to drawing 5 (d) and drawing 5 (e). The sectional view cut in respect of [JKL] drawing 4 is the same as drawing 3. Although over etching of the first conductor layer 5 is carried out and it becomes thin as shown in drawing 2 also in

this case, a film piece can be prevented by adjusting the thickness of the first conductor layer 5.

[0023] The structure of drawing 4 is the structure where exfoliation cannot take place easily since the plane-of-composition product is large compared with drawing 1. However, with the structure of drawing 4, since the width of face of the direction of GH of the first conductor layer 5 must be smaller than the width of face of the second conductor layer 7, it is easy to concentrate stress on the level difference section of the first conductor layer 5. On the other hand, since the structure of drawing 1 does not receive such a limit in the width of face of the AB direction of the first conductor layer 5, it can ease the stress concentration in the level difference section by enlarging width of face of the AB direction in the level difference section of the first conductor layer 5. Therefore, in respect of relaxation of the stress concentration of the level difference section, the direction of the structure of drawing 1 is excellent.

[0024] Next, the junction structure of the thin film magnetic head for magnetic disk drives which is the 2nd example of this invention is explained using drawing 13 from drawing 6. These have the structure where the insulator does not intervene at other parts, although placed between a part of plane-of-composition rim sections of the first conductor layer 5 and the second conductor layer 7 by the insulator. 38 of drawing 6 and the part of 39 express the location between which it is placed by the insulator. The sectional view cut in respect of [ABC] drawing 6 is completely the same as drawing 2 (e). Thus, if the number of the fields which planes of composition have joined to the plane-of-composition rim section directly is also one, the stress of exfoliation [structure / according to which it was placed between the whole plane-of-composition rim sections by the insulator / junction] will be reduced.

[0025] Drawing 7 has the field which planes of composition have joined to the plane-of-composition rim section directly so that the sectional view cut in respect of RST to drawing 8 may be shown, and the stress of exfoliation [structure / according to which it was placed between the whole plane-of-composition rim sections by the insulator / junction] is reduced. In addition, the structure of drawing 7 is excellent in the point that over etching of the first conductor layer 5 is not carried out.

[0026] Moreover, over etching of the first conductor layer 5 is not carried out like [the example shown in drawing 9] the structure of drawing 7. Drawing 10 is the sectional view cut by field R'S'T' of drawing 9. As shown in drawing 10, this example also has the field which planes of composition have joined to the plane-of-composition rim section directly in this way, and the stress of exfoliation [structure / according to which it was placed between the whole plane-of-composition rim sections by the insulator / junction] is reduced.

[0027] When the first conductor layer 5 and the second conductor layer 7 connect with an include angle, there is [*****] junction structure like drawing 11. Drawing 12 is the sectional view cut in respect of [XYZ] drawing 11, and drawing 13 is the sectional view cut by field X'Y'Z' of drawing 11. As shown in these drawings, this example also has the field which planes of composition have joined to the plane-of-composition rim section directly, and the stress of exfoliation [structure / according to which it was placed between the whole plane-of-composition rim sections by the insulator / junction] is reduced.

[0028] Next, the thin film magnetic head for magnetic disk drives as the 3rd example of this invention is explained using drawing 14 - drawing 17. Although the 3rd example is an inductive head of a three-tiered structure which consists of the first conductor layer 5, the second conductor layer 7, and the third conductor layer 14, this invention cannot be restricted to this and can be applied also to a magneto-resistive effect (MR) head. Drawing 14 is drawing which looked at the substrate 1 from the upper part, and the sectional view and drawing 16 which cut drawing 15 by UV in drawing 14 are the sectional view cut by VW in drawing 14. This example is explained in accordance with a manufacture process. First, after forming the substrate film 2, the first magnetic substance 17, and the gap material 3 by the spatter on a substrate 1 and applying insulators, such as a photoresist, on it, it hardens by heat treatment and the first insulator layer 4 with a flat front face is formed. Besides, it etches by forming the first conductor layers 5, such as copper which has thin glue lines, such as chromium, on the inferior surface of tongue. Then, it heat-hardens, after applying the second insulator layer 6 which consists of a photoresist etc. and exposing and developing negatives. Under the present circumstances, it is made exposed [the plane-of-composition rim section of the first conductor layer 5] about the part used as the joint 19 of the first conductor layer 5 and the second conductor layer 7 the same with having been shown in drawing 2 (c) and drawing 3 (c). Next, the second conductor layers 7, such as copper which has thin glue lines, such as chromium, on a top face and the inferior surface of tongue, for example, are formed, and this is etched. Under the present circumstances, in the joint 19 of the first conductor layer 5 and the second conductor layer 7, it etches like drawing 2 (d), drawing 2 (e), drawing 3 (d), and drawing 3 (e), and the third insulator layer 20, the third conductor layer 14, and the fourth insulator layer 21 are formed further. The structure of the joint 15 of the second conductor layer 7 and the third conductor layer 14 is manufactured like the joint 19 of the first conductor layer 5 and the second conductor layer 7. Next, the second magnetic substance 18 is formed by a spatter etc. In this case, it considers as the structure where an insulator does not intervene about the joint 16 of the second magnetic substance 18 and the third conductor layer 14, either, according to the same manufacture process as drawing 5.

[0029] Since conductors, such as copper which constitutes the thin film magnetic head, and insulators, such as a photoresist, have the large difference of a coefficient of thermal expansion, with the junction structure between which it was placed by the conventional insulator, the stress which exfoliates a joint becomes large. Therefore, especially this invention has a large improvement effect, when it applies to the thin film magnetic head.

[0030] In the thin film magnetic head of the above-mentioned example, although the structure shown in drawing 1 was used for the structure of the joint 19 of the first conductor layer 5 and the second conductor layer 7, and the joint 15 of the second conductor layer 7 and the third conductor layer 14, it may be transposed to the structure shown in drawing 4, drawing 6, or drawing 7.

[0031] Moreover, otherwise as the thin film magnetic head by this invention, the structure of drawing 17 can be considered. The difference from drawing 14 is that the joint 15 of the second conductor layer 7 and the third conductor layer 14 is located in the part which is not covered with the second magnetic substance 18, and has structure which complicated stress distribution cannot produce easily. For this reason, there is an advantage that the magnetic properties of the second magnetic substance 18 are maintained at stability.

[0032] When the magnetic head which has the conventional junction structure is used, the exfoliating stress produces the joint between conductors by the thermal expansion of an insulator, and since the stress becomes so large that the thickness of the film which constitutes the magnetic head is thick, it can seldom thicken thickness. In the magnetic head which has the junction structure of this invention, since such stress by the thermal expansion of an insulator is reduced, thickness of the film which constitutes the magnetic head can be thickened. Since only the part which thickened thickness of a conductor can make width of face of a conductor coil small, without enlarging resistance of a conductor, it can be referred to as suitable for the densification of a conductor coil.

[0033] Next, the magnetic disk drive of the 4th example of this invention is explained using drawing 18. This example consists of the magnetic disk 24 as a magnetic-recording medium, the thin film magnetic head 22 by this invention, an actuator means for moving the magnetic head to the predetermined location on a magnetic disk, and a control means that controls transmission and reception of the data which reading, and migration and the magnetic head 22 of an actuator means write like the usual magnetic disk drive.

[0034] Below, it explains in more detail including actuation. If the slider 23 which supports the magnetic head 22 is placed on the magnetic disk 24 supported with the revolving shaft 29 and this magnetic disk 24 rotates with a drive motor 30, a slider 23 will surface a magnetic-disk 24 top. A slider 23 is attached in an arm 26 by the gimbal 25 which has elastic force. When the elastic force and the air bearing force of a gimbal 25 balance, it is maintained at fixed distance between a slider 23 and a magnetic disk 24. A control unit 33 lets Rhine 31, Rhine 32, and Rhine 28 pass, transmits or receives a control signal, and controls actuation of a magnetic disk drive. A drive motor 30 is controlled by the control unit 33 through Rhine 31. The actuators 27, such as a voice coil motor, let Rhine 28 pass, and are controlled to move and position a slider 23 in the predetermined location on a magnetic disk 24. The data on the magnetic disk 24 which the magnetic head 22 read are changed into an electrical signal, and are decoded through Rhine 32. Moreover, the data written in on a magnetic disk 24 are transmitted to the magnetic head 22 through Rhine 32 as an electrical signal.

[0035] When the conventional thin film magnetic head was used as the magnetic head of this magnetic disk drive, the exfoliating stress produced the joint between conductors by the thermal expansion of an insulator, and since that stress became so large that the thickness of the film which constitutes the magnetic head is thick, it was seldom able to thicken thickness. Since such stress by the thermal expansion of an insulator is reduced when the thin film magnetic head which has the junction structure of this invention is used, thickness of the film which constitutes the magnetic head can be thickened. Only the part which thickened thickness of a conductor can make width of face of a conductor coil small, without enlarging resistance of a conductor. If this is considered in the example of drawing 14 or drawing 17, it will lead to the ability of the radius of a spiral coil to be made small. If the effectiveness that the insulators by which it was placed between the joint rim sections are reduced is also doubled and taken into consideration, since the pattern of a component can be made small, thickness of a slider 23 can be made thin as a result. In this way, a slider 23 can be accessed by making mass of a slider 23 small and miniaturizing size in the predetermined location on a magnetic disk 24 at a high speed. The burden furthermore placed on a gimbal 25 or an arm 26 can also be reduced.

[0036]

[Effect of the Invention] According to this invention, the densification of the thin film magnetic head and a miniaturization can be attained, and the densification of a magnetic disk drive and rapid access-ization are attained.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]

- [Drawing 1] It is thin film junction structural drawing of the 1st example of this invention.
 [Drawing 2] It is the process sectional view of the thin film junction structure of drawing 1.
 [Drawing 3] It is the process sectional view of the thin film junction structure of drawing 1.
 [Drawing 4] It is thin film junction structural drawing of the 1st example of this invention.
 [Drawing 5] It is the process sectional view of the thin film junction structure of drawing 4.
 [Drawing 6] It is thin film junction structural drawing of the 2nd example of this invention.
 [Drawing 7] It is thin film junction structural drawing of the 2nd example of this invention.
 [Drawing 8] It is the sectional view of the thin film junction structure of drawing 7.
 [Drawing 9] It is thin film junction structural drawing of the 2nd example of this invention.
 [Drawing 10] It is the sectional view of the thin film junction structure of drawing 10.
 [Drawing 11] It is thin film junction structural drawing of the 2nd example of this invention.
 [Drawing 12] It is the sectional view of the thin film junction structure of drawing 11.
 [Drawing 13] It is the sectional view of the thin film junction structure of drawing 11.
 [Drawing 14] It is thin film magnetic-head structural drawing of the 3rd example of this invention.
 [Drawing 15] It is the sectional view of the thin film magnetic head of drawing 14.
 [Drawing 16] It is the sectional view of the thin film magnetic head of drawing 14.
 [Drawing 17] It is thin film magnetic-head structural drawing of the 4th example of this invention.
 [Drawing 18] It is the block diagram of the magnetic disk drive of the 5th example of this invention.
 [Drawing 19] It is the explanatory view of the joint exfoliation mechanism of the conventional thin film junction structure.

[Description of Notations]

1 [— The first insulator layer 5 / — The first conductor layer,] — A substrate, 2 — The substrate film, 3 — Gap material, 4 6 — The second insulator layer, 7 — The second conductor layer, 8, 9, 10 — The plane-of-composition rim section of the first conductor layer, 11 [— The second magnetic substance,] — A mask, 14 — The third conductor layer, 17 — The first magnetic substance, 18 20 [— A slider, 24 / — A magnetic disk, 25 / — A gimbal, 26 / — An arm, 27 / — An actuator, 29 / — A revolving shaft, 30 / — A drive motor, 33 / — A control unit, 37 / — Protective coat.] — The third insulator layer, 21 — The fourth insulator layer, 22 — The magnetic head, 23

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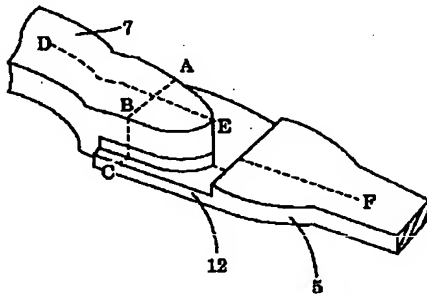
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DRAWINGS

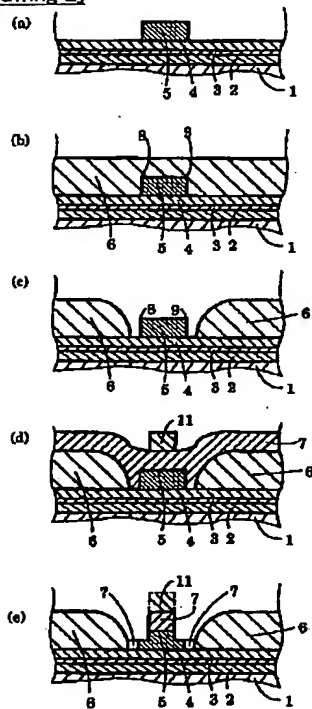
[Drawing 1]

図1



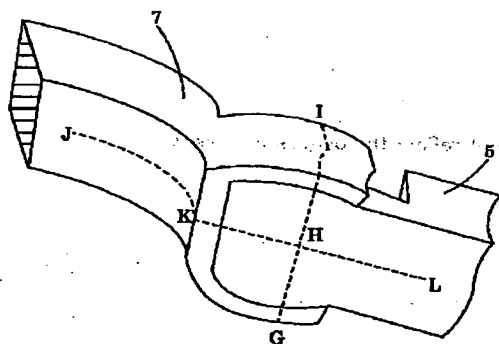
[Drawing 2]

図2



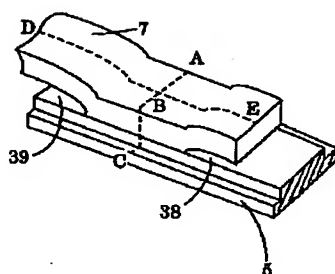
[Drawing 4]

図4



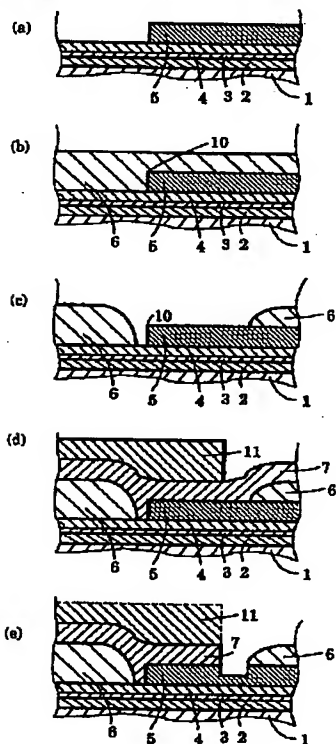
[Drawing 6]

図6



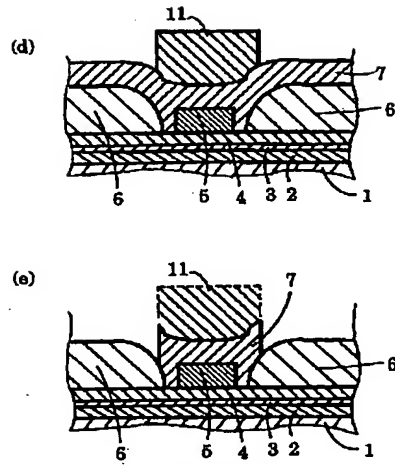
[Drawing 3]

図3



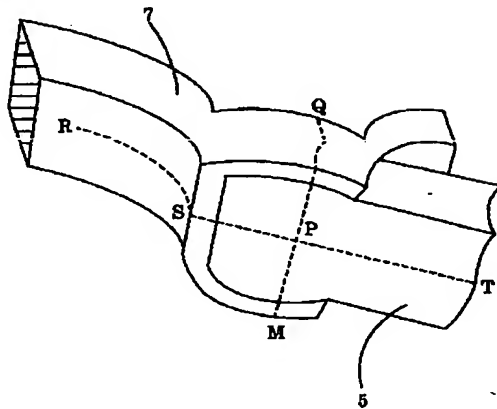
[Drawing 5]

図5



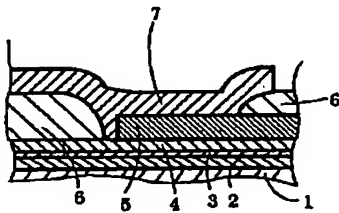
[Drawing 7]

図7



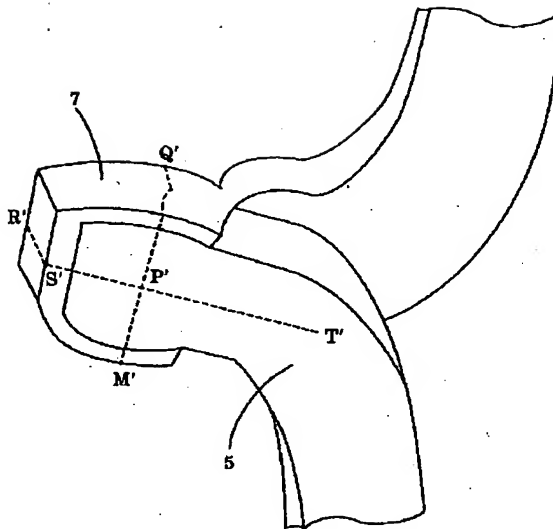
[Drawing 8]

図8

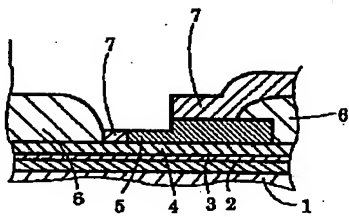


[Drawing 9]

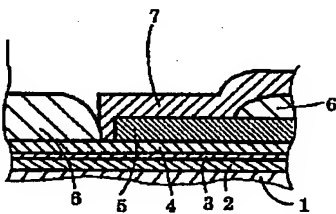
図9



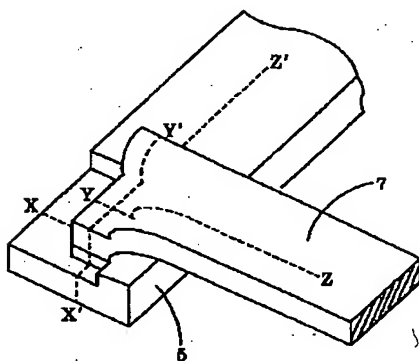
[Drawing 12]
図12



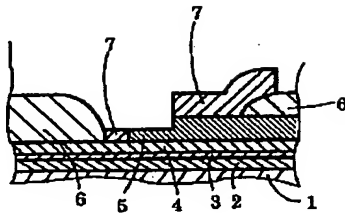
[Drawing 10]
図10



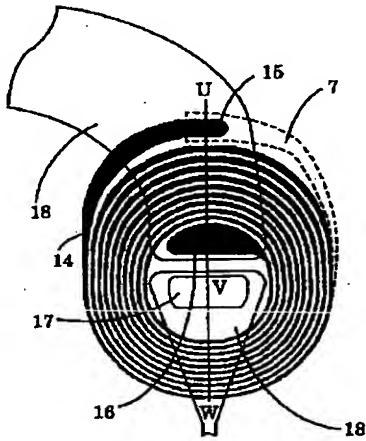
[Drawing 11]
図11



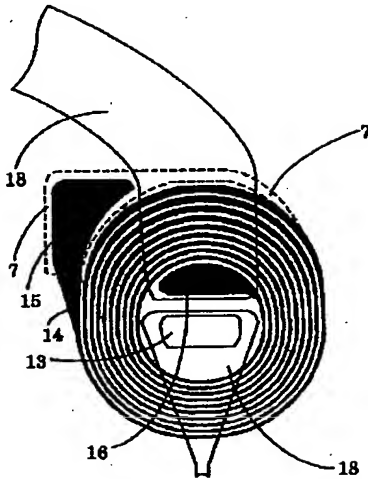
[Drawing 13]
図13



[Drawing 14]
図14

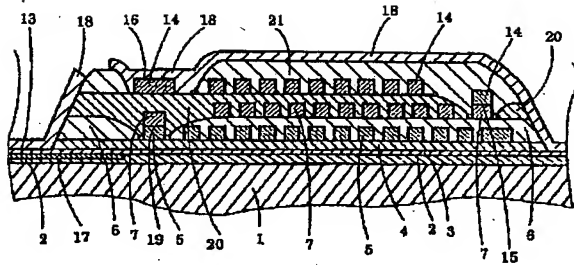


[Drawing 17]
図17

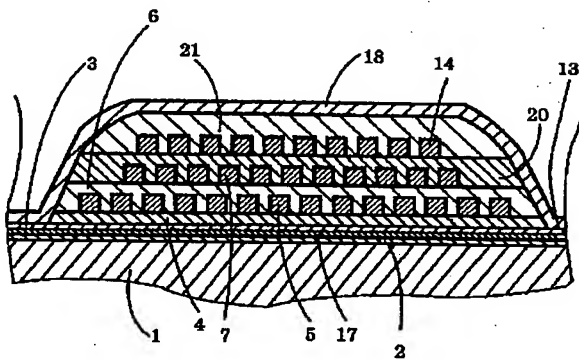


[Drawing 15]

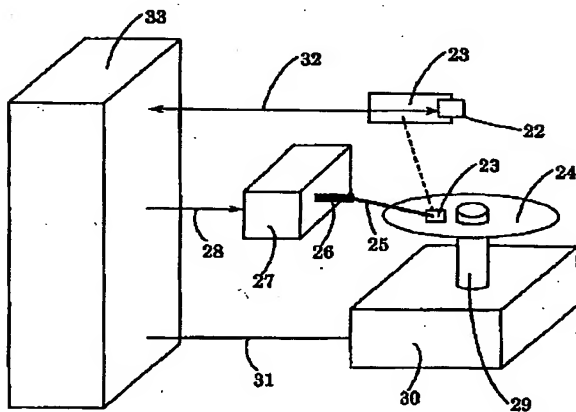
図15



[Drawing 16]
図16

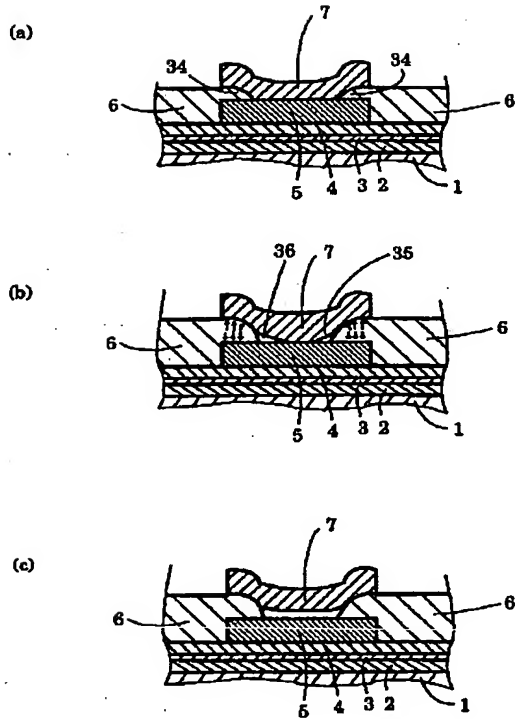


[Drawing 18]
図18



[Drawing 19]

図19



[Translation done.]

SECRET

